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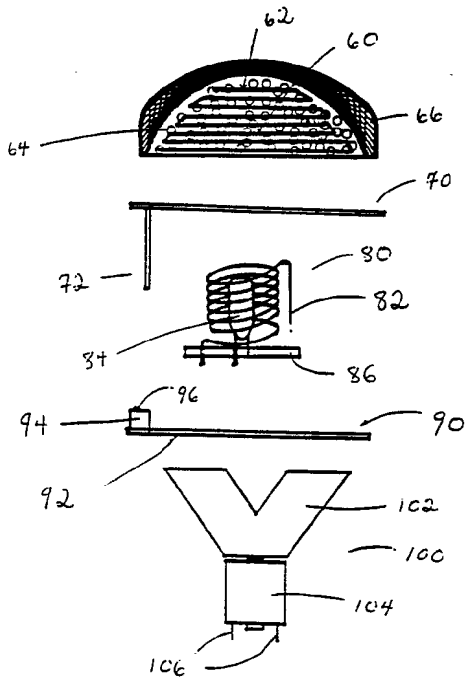

(57) Abstract

An air cleaning unit effectively removes pollutants from the air. The air cleaning unit is relatively compact and can be powered by a standard electrical socket. The air cleaning unit can function as an illuminating light and fragrance dispenser also. The air cleaning unit has a filter (60) and an electromagnetic field creator (82) through which a fan (100) forces air.

* See back of page

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AN AIR CLEANING UNIT

This application is a continuation-in-part of application serial no. 378,088 filed July 11, 1989.

Background of the Invention

This invention relates to an air cleaning unit, and more particularly to an air cleaning unit which can effectively remove pollutants from the air, is relatively compact, can be powered by a standard electrical socket and which can have other functions as well, such as light illumination and the dispensing of fixed amounts of fragrance into the air.

Numerous patents have issued in which air cleaning units are taught and described. These teachings are documented in, for example, U.S. Pat. No. 4,376,642 issued March 15, 1983 to Biotech Electronics Ltd.; U.S. Pat. No. 3,735,560 issued May 29, 1973 to D.C. Wellman; U.S. Pat. No. 3,783,588 issued January 8, 1974 to M. Hundis; U.S. Pat. No. 3,861,894 issued January 21, 1975 to R.C. Marsh; U.S. Pat. No. 4,114,082 issued September 19, 1978 to J.H. Newell; U.S. Pat. No. 4,133,653 issued January 9, 1979 to C.W.

Soltis; U.S. Pat. No. 4,215,682 issued August 1980 to Kubik et. al.; U.S. Pat. No. 3,744,216 issued July 10, 1973 to Halloran; U.S Pat. No. 3,841,840 issued October 15, 1974 to Hundhausen; U.S. Pat. No. 3,587,210 issued June 28, 1971 to Shriner; U.S. Pat. No. 4,133,652 issued January 9, 1979 to Ishikawa et. al.; U.S. Pat. No. 3,191,362 issued June 29, 1965 to Bourgeois; U.S. Pat. No. 3,853,529 issued December 10, 1974 to Boothe et. al.; U.S. Pat. No. 3,828,530 issued August 13, 1974 to Peters; U.S. Pat. No. 3,860,404 issued January 14, 1975 to Jochimski; U.S. Pat. No. 2,790,510 issued April 30, 1957 to J.G. Brabec; U.S. Pat. No. 4,261,712 issued April 14, 1981 to Kinkade, U.S. Pat. No. 3,804,942 issued April 16, 1974 to Takaskhi; U.S. Pat. No. 4,252,547 issued February 24, 1981 to Johnson; German Pat No. DT2732859 issued February 1, 1979 to Wagner; French Pat. No. 1,193,100 issued October 30, 1959; and U.S.S.R. Pat. No. 606,602 issued May 25, 1978. Pat. No. 4,069,026 issued January 17, 1978 to Sim et. al. teaches a method for producing electrostatically spun fibers.

Conventional air cleaning units are, for the most part, limited to accomplishing only certain air filtering or purifying tasks, large apparatus' that cannot easily fit within the available space, and cannot be employed to perform anything other than certain particular limited functions.

It would be advantageous, and an improvement over prior art air cleaning units, to have an air cleaning unit which can effectively filter and purify air, is relatively compact, is powered by a standard electrical socket and which can have other functions, such as light illumination and the dispensing of

controlled amounts of fragrance into the air. No air cleaning unit taught by the prior art can accomplish all of the following tasks: collect particles, sterilize air, act on organic gases including carbon monoxide and remove poisonous gases from the air, in addition to providing light and dispensing fragrance. The air cleaning unit of this invention accomplishes all of these tasks effectively.

This improvement is achieved by passing air to be purified through a new filtering means in the air cleaning unit which filtering means comprises a means for creating an electromagnetic field. The filtering means is adapted to collect particles, namely, dust, pollen, cigarette smoke and other submicron particulate contaminations, and to oxidize and ionize certain substances in the air namely, fumes and pollutants. A light source, contained in one embodiment of the unit, which has a wide wavelength spectrum (i.e., it has frequences from far UV-C to far Infra Red) further enchances the effectiveness of the unit by emitting heat and UV wavelengths. The heat causes various reactions occurring in the unit to move forward more rapidly. The UV wavelengths have germicidal properties to destroy and kill microorganisms.

Summary of the Invention

The present invention is directed to providing an air cleaning unit which can effectively remove pollutants from the air, is relatively compact, is powered by a standard electrical socket, and which can have other functions as well, such as light

illumination and the dispensing of fixed amounts of fragance into the air.

In an illustrative embodiment of the invention, the filter means comprising an electromagnetic field created by current flowing along a coiled wire and further comprising a new filter, in combination with a light source, create an environment in a housing, forming a semi-enclosed volume, which effectively filters and purifies air passing through the air cleaning unit by removing particulates and by oxidizing or breaking certain pollutants in the air to less harm pollutants. The air is moved across the filter means by a fan means contained within the body of the housing.

Brief Description of the Drawings

The foregoing and other features of the present invention will be more readily apparent from the following detailed description of the invention in which:

Fig. 1. is an exploded cross-sectional view of the housing of the air cleaner unit;

Fig. 2. is an exploded view, partially in cross-section, of the internal components of the air cleaning unit;

Fig. 3. is an exploded view of, partially in cross-section, of the housing of the air cleaner unit and of the layout thereof, showing how said components fit within said housing;

Fig. 4. and Fig. 5 are sectional views of preferred embodiments of a filter which can be used in the air cleaning unit;

Fig. 6. is a perpective view of a light source used in the air cleaning unit and wire coiled around said light source, said coiled wire being in parallel with said source;

Fig. 7. is a perspective view of a light source and wire coiled around said light source, said coiled wire being in parallel with said light source, and said coiled wire having an additional coil in series;

Fig. 8. is a perspective view of a light source used in the air cleaning unit and a wire coiled around said light source, said coiled wire being in series to said light source;

Fig. 9. is a perspective view of a light source and wire coiled around said light source, said coiled wire being in series with said light source and said coiled wire having an additional coil in series;

Each of Figures 6-9 show a base upon which the light source and coiled wire can be located.

Fig. 10. is a top view of one embodiment of the printed circuit upon which a light source, coiled wire and base are located;

Fig. 11. is a cross-sectional view of a fragrance dispensor to be used with the air cleaning unit at any strategic location in the air cleaning unit;

Fig. 12. is a top view of said fragrance dispensor;

Fig. 13. is a bottom view of the base of said fragrance dispensor; and

Fig. 14. is a cross-sectional view of the fragrance dispensor and filter, showing how said fragrance dispensor can be adapted to fit into a filter used in the air cleaning unit.

Fig. 15. is a cross-sectional view, partially in section, of the air cleaning unit.

Description Of Illustrative Embodiments

Figure 1 shows the external structure of the air cleaning unit. Upper housing 20 contains perforations 22 for the passage of air into or out of chamber 24 located in the upper housing. Upper housing 20 is detachably engaged with mid-housing 30. Mid-housing 30 forms a cylindrically shaped chamber 32 open from both sides. Mid-housing 30 is detachably engaged with a frusto-conical shaped lower housing 40 with neck 41. Lower housing 40 has perforations 42 for the passage of air out of or into the lower housing. Neck 41 is adapted to fit into socket 50. Socket 50, with threading 52, is a conventional light bulb socket which can be screwed into a conventional light fixture.

Upper housing 20, mid-housing 30 and lower housing 40 are made of a transparent, or semi-transparent, material such as plastic or glass which is contaminated with UV absorbant material, which, however, allows other light wavelengths to pass through the material, to illuminate the area. The ideal material is an unbreakable plastic with high resistance properties to prevent electric shock. The number of housing parts contained in the air cleaner unit housing can, of course, vary. The multi-part housing permits any combination of colors to be used for the housing, that is, each part of the housing may have a different color. It also allows control of the color of the light emitted from the air cleaning unit.

Figure 2 depicts the internal components of the air cleaning unit. A preferred embodiment of filter 60 contains wire mesh 62, which is a conductive material,

preferably iron, and activated carbon granuals 64 encased in said wire mesh 62. On the top end of filter 60 there can be a sponge-like material 66 which can contain a means which acts as an indicator by changing color when the filter needs to be replaced. Sponge-like material 66 can also simply be coated with said color indicating means. Filter 60 can have any shape but a shape which fits within and is co-extensive with chamber 22 of upper housing 20 is preferred. Filter 60 sits on holder 70, which holds filter 60 in position within upper housing 20. Holder 70 is adapted to allow air to freely flow into or out of chamber 32 of mid-housing 30. Holder 70 has a vertical extension 72 whose lower end is in contact with switch activator 96 located on switch 94 in the operating air cleaning unit. When vertical extension 72 is in contact with switch activator 96, the switch is closed and electric current can pass through switch 94. If vertical extension 72 is moved from such a position, such as when the air cleaning unit is taken apart, switch 94 is opened and current ceases to flow past the switch. This prevents electric shock and is an important safety feature.

Figure 2 also depicts coiled wire 82 and light source 84, both positioned on base 86. Base 86 is a heat resistant ceramic-like material. Base 86 is positioned on printed circuit 90. Switch 94 and switch activator 96 are also positioned on printed circuit 90. Printed circuit 90 is located above fan 100 comprising impeller 102 and motor 104 for operating the fan. Motor 104 has electrical wires 106 for connecting it to current. The motor operates on either high or low voltage and on either AC or DC

power. The fan have one or more impellers 102 which, when circulating, move air from perforations 22 in upper housing 20, through chamber 22 and then through chamber 32, into lower housing 40, and finally out of perforations 42 located in lower housing 40, or vice versa.

Figure 3 depicts both the internal and external components of the air cleaning unit and how they are positioned relative to each other. Motor 104 fits into neck 41 of lower housing 40. Neck 41 fits into socket 50. Fan 100 fits entirely into the chamber formed by lower housing 40. Fan 100 should be positioned as low as possible inside lower housing 40. Impellers 102 are designed for maximum efficiency within the chamber formed by lower housing 40. Printed circuit 90 is adapted to fit on the upper end of lower housing 40. Switch 94, base 86, light element 84 and coiled wire 82, all of which sit on printed circuit 90, are located in chamber 32 of mid housing 30. Holder 70 is adapted to fit on the upper end of mid housing 30. Filter 60, which sits on holder 70, is located in chamber 22 formed by upper housing 20. Alternatively, the filter may be held in place by any attachment means in the upper housing, and vertical extension 72 can protrude from the upper housing, thereby obviating the need for holder 70.

In a preferred embodiment of the invention, air is purified as follows: air is drawn through perforations 22 into filter 60 by the movement of impellers 102. Activated carbon 64 in filter 60 absorbs certain pollutants and reacts with other pollutants. The efficiency of the activated carbon to react with pollutants is increased by the heat emitted from a light source, this is especially the case when the

activated carbon works by chemically reacting with the pollutants. Wire mesh 62 in filter 60 blocks particles. More particles are blocked when the wire mesh has a higher density. Wire mesh 62 can be any metal or metal oxide, but is ideally iron, zinc oxide or copper oxide. Sponge-like material 66 on top of filter 60 is designed to collect fine particles and to contain a color indicator means which tells the user when filter 60 needs to be replaced. The purification of air by filter 60 is enhanced by induced current in the wire mesh caused by the electromagnetic field creating means and also by heat emitted from the light source. That is, the induced current in wire mesh 62 and heat catalyze oxidation and other chemical reactions in filter 60, thereby allowing for the conversion of certain poisonous gases into less harmful gas. Thus, reactions such as the following take place: $CO + H_2O \longrightarrow H_2 + CO_2$. The reaction rate is increased by wire mesh 62, which acts as a catalyst, as follows:

$$CO + 1/2\ O_2 \xrightarrow{CU_2O} CO_2;\ SO_2.$$

Additionally, the induced current in wire mesh 62 improves the ability of activated carbon 64 to react with gases.

As air passes out of filter 60 and enters mid housing chamber 32, certain UV radiation wavelengths emitted by light source 84 kill microorganisms. Heat in chamber 32 generated by light source 84 increases the efficiency of the UV wavelengths on microorganisms. Additionally, UV wavelengths and heat catalyze oxidation and other chemical reactions in the air cleaning unit. For instance, the following reaction

takes place under the conditions found in chamber 32: $2NO_2$ + UV + heat ——> 2NO + O_2. Heat also catalyzes reactions such as $2O_3$ + Heat ——> $3O_2$. Heat in chamber 32 also increases the ionization of gases, thereby increasing the effect that certain UV wavelengths have on microorganisms and increasing oxidation reactions.

The current flowing through coiled wire 82 causes an electromagnetic field around the coil. The electromagnetic field causes ionization of gases. Furthermore, the electromagnetic field causes current to be induced in wire mesh 62 of filter 60. That is, the current flowing through coiled wire 82, by induction, causes induced current to flow in wire mesh 62 of filter 60. Ionization caused in chamber 32 and at and around filter 60 have at least two major purposes: 1) ionization per se causes the breakdown of certain harmful pollutants and 2) ionization of gases increases the rate of oxidation. The efficiency of the air cleaning unit can be increased by increasing the frequency of the current (such as by chopping AC voltage). This is so because increased current causes an increase in the electromagnetic field, thereby increasing ionization of air. It should be noted that air purification occurs in two stages -- at chamber 24 which contains filter 60 and at chamber 32. The purified air is forced out of the housing through perforations 42.

Figure 4 depicts one of many possible filters that can be used with the air cleaning unit, this filter being a preferred filter. The filter comprises a wire mesh 62 and activated carbon 64 contained within said wire mesh. The wire mesh 62 and activated carbon are

encased in a screen net of metal fibers 68. A sponge-like material 66 is located on the top semicircular portion of filter 60. The sponge-like material may be impregnated or coated with a means which acts as an indicator and changes color when the filter needs to be replaced. The indicator means may be located in any location within the housing of the air cleaning unit or it can even be attached to the outside structure of the housing. Sponge-like material 66 has electrical isolated properties and is covered with casing 69 made of nonconductive isolated fibers.

Figure 5 depicts another possible filter comprising a wire mesh 62 and activated carbon 64 contained therein, all encased in a screen net of metal fibers 68. In even another embodiment not shown in the drawings, filter 60 can consist of activated carbon 64 attached to acrylic fibers, said acrylic fibers being in a shape similar to wire mesh 62. The activated carbon and acrylic filters are enclosed in a net of acrylic fibers. Alternatively, the acrylic fibers, both in the mesh and in the net, can also be coated with catalizing materials such as metal oxides. Moreover, catalytic materials in the form of granuales can also be attached to the acrylic fibers. Filter 60, of course, can consist of any combination of wire mesh, acrylic fibers and coated acrylic fibers. The shape of the filter is variable. It can even be shaped to have a donut-shaped hole which permits insertion of a fragrance dispenser within the hole, as shown in Fig. 14.

Figure 6 shows one of four possible electrical configurations of coiled wire 82 and light source 84. Figures 6 and 7 show light source 84 and coiled wire

82 connected in parallel. Pins 87 connect the coiled wire to a current source. Pins 89 connect the light source to a current source. Figure 7 differs from Fig. 6 in that it contains an additional coiled wire 88 in series. Additional coiled wire 88 increases the electromagnetic field created because current flows through each of coiled wire 82 and coiled wire 88, thereby increasing the induction occurring in the air cleaning unit. Fig. 8 and Fig. 9 show coiled wire 82 and light source 84 connected in series. Thus pins 87 and 89 connect both the coiled wire and light source to a current source. Fig. 9 differs from Fig. 8 in that it contains an additional coiled wire 88 in series for the same purpose as that shown in Fig. 7.

A preferred embodiment of light source 84 is a replaceable halogen bulb because it emits a wide spectrum of wavelengths and a great amount of heat. A halogen bulb is also preferred because of its small dimension, long life expectancy and high ratio of light/power to save energy. As can be seen, coiled wire 82 surrounds light source 84. The number of turns in the coil are variable and are calculated to absorb the maximum heat from the bulb and to allow maximum illumination from the bulb. Coiled wire 82 serves many purposes. It absorbs heat thereby protecting the housing of the air cleaner unit and other components from over-heating. It also serves to cool light source 84. It protects the air cleaning unit from electric surges. It prolongs the lifetime of light source 84 because the coiled wire resists quick current changes which occur when one switches the light on and off. It creates an electromagnetic field in chamber 32, which causes ionization of gases

in chamber 32 and which catalyzes oxidation and other reactions in chamber 32. It also induces current in wire mesh 62 of filter 60. The induced current in wire mesh 62 ionizes gases and also thereby catalyzes oxidation and other reactions in chamber 24. Coiled wire 82 can be made of many different metals but the preferred metals are nickel and copper. These two metals are particularly effective catalysts for the reactions which take place in the air cleaning unit. Coiled wire 82 can also be made of any substance and then simply coated with a substance which will act as a strong catalyst. The surface of coiled wire 82 can be smooth. In a preferred embodiment, however, the surface of coiled wire 82 is rough. A rough surface has a larger surface area which absorbs more heat. A rough surface also has sharp angles which increases the electromagnetic field and thereby the ionization in the air surrounding the coiled wire.

Figure 10 depicts a top view of printed circuit 90, also shown in Figures 2 and 3. Apertures 92 are adapted to permit pins 87 and 89 to connect to a current source. Apertures 98 are adapted to permit switch 94 to connect to a current source.

The air cleaning unit can be made with or without an optional fragrance dispenser. Figure 11 shows a housing for dispensing fragrance into the air that is passing through the air cleaning unit. Figure 12 shows a top view of cover 120 of said fragrance housing having an air regulator means 122 which regulates the passage of air into fragrance chamber 132. As cover 120 is rotated to the right, opening 124 becomes wider over space 131 in the upper portion 136 of fragrance housing 130, thus permitting a larger

amount of air into fragrance chamber 132. A larger amount of air in fragrance chamber 132 causes fragrance to move into capillary pipe 134. Thus, the amount of fragrance dispensed can be regulated in controlled measured amounts. The fragrance moves through capillary pipe 134 into base 140 in the lower portion of fragrance housing 130. Figure 13 shows a bottom view of base 140. Sponge-like material or other absorbant material 142 absorbs the fragrance traveling through capillary pipe 134. As air passes through the air cleaner unit, it comes into contact with sponge-like material or other absorbant material 142 containing fragrance causing diffusion of fragrance into the air. Thus, the air which passes out of the air cleaner unit through perforations 42 can contain fragrance. Although fragrance housing 130 can be located at various strategic places within the air cleaning unit, in the preferred embodiment of the invention, fragrance housing 130 is located within filter 60. Threading 138 lodges fragrance housing 130 securely into place.

As can be seen in Figure 14, fragrance dispenser 130 is positioned in filter 60 so that air can pass into opening 131 and so that sponge-like material or other absorbant material 142 is exposed to air passing out of filter 60, to permit diffusion of fragrance into the air. Fragrance dispenser 130 can be made with the same material used in making the housing for the air cleaning unit.

Figure 15 is a cross-sectional view, partially in section, of the air cleaning unit described above.

While the invention has been particularly shown and described with reference to preferred embodiments

thereof, it will be understood by those skilled in the art that various changes in form and details may be made therein without departing from the spirit and scope of the invention.

WHAT IS CLAIMED IS:

1. An air cleaning unit for moving air therethrough comprising:

a) a housing forming a semi-closed volume;

b) an inlet and an outlet of said housing for the passage of air into said inlet, through said housing, and out of said outlet;

c) a fan means positioned within said semi-closed volume for causing air to flow from said inlet to said outlet;

d) a filter means positioned within said semi-closed volume, between said inlet and said outlet, for removing pollutants from the air flowing from said inlet to said outlet, said filter means comprising a means for creating an electromagnetic field in said housing, said fan means further causing air to flow through said filter means; and

e) means for connecting said fan means and said electromagnetic field creating means to a power supply.

2. An air cleaning unit as in claim 1 wherein said electromagnetic field creating means is a wire through which current may flow.

3. An air cleaning unit as in claim 2 further comprising a light source.

4. An air cleaning unit as in claim 3 wherein said wire is coiled around said light source.

5. An air cleaning unit as in claim 4 wherein said wire coiled around said light source are connected in series.

6. An air cleaning unit as in claim 1 wherein said filter means further comprises a filter.

7. An air cleaning unit as in claim 6 wherein said filter comprises mesh means for trapping pollutants.

8. An air cleaning unit as in claim 7 wherein said mesh means is acrylic fibers coated with a catalytic material.

9. An air cleaning unit as in claim 7 wherein said mesh means is a wire mesh.

10. An air cleaning unit as in claim 7 wherein said filter further comprises activated carbon contained within said mesh means.

11. An air cleaning unit as in claim 6 wherein said filter comprises a sponge-like material attached to said filter, said sponge-like material containing an indicator means for determining when said filter needs replacement.

12. An air cleaning unit as in claim 6 wherein said filter comprises a fragrance dispensing means contained within said filter.

13. An air cleaning unit as in claim 6 wherein said electromagnetic field creating means is a wire through which current may flow.

14. An air cleaning unit as in claim 13 further comprising a light source.

15. An air cleaning unit as in claim 14 wherein said wire is coiled around said light source.

16. An air cleaning unit as in claim 15 wherein said wire coiled around said light source are connected in series.

17. An air cleaning unit as in claim 7 wherein said electromagnetic field creating means is a wire through which current may flow.

18. An air cleaning unit as in claim 17 further comprising a light source.

19. An air cleaning unit as in claim 18 wherein said wire is coiled around said light source.

20. An air cleaning unit as in claim 19 wherein said wire coiled around said light source are connected in series.

21. An air cleaning unit as in claim 8 wherein said electromagnetic field creating means is a wire through which current may flow.

22. An air cleaning unit as in claim 21 further comprising a light source.

23. An air cleaning unit as in claim 22 wherein said wire is coiled around said light source.

24. An air cleaning unit as in claim 23 wherein said wire coiled around said light source are connected in series.

25. An air cleaning unit as in claim 9 wherein said electromagnetic field creating means is a wire through which current may flow.

26. An air cleaning unit as in claim 25 further comprising a light source.

27. An air cleaning unit as in claim 26 wherein said wire is coiled around said light source.

28. An air cleaning unit as in claim 27 wherein said wire coiled around said light source are connected in series.

29. An air cleaning unit as in claim 10 wherein said electromagnetic field creating means is a wire through which current may flow.

30. An air cleaning unit as in claim 29 further comprising a light source.

31. An air cleaning unit as in claim 30 wherein said wire is coiled around said light source.

32. An air cleaning unit as in claim 31 wherein said wire coiled around said light source are connected in series.

33. An air cleaning unit as in claim 11 wherein said electromagnetic field creating means is a wire through which current may flow.

34. An air cleaning unit as in claim 33 further comprising a light source.

35. An air cleaning unit as in claim 34 wherein said wire is coiled around said light source.

36. An air cleaning unit as in claim 35 wherein said wire coiled around said light source are connected in series.

37. An air cleaning unit as in claim 6 further comprising an indicator means for determining when said filter needs replacement.

38. An air cleaning unit as in claim 1 further comprising a fragrance dispensing means for dispensing fragrance into the air.

39. An air cleaning unit as in claim 3 wherein said light source is a halogen bulb.

40. An air cleaning unit as in claim 3 wherein said housing is a transparent material.

41. An air cleaning unit as in claim 3 wherein said housing is contaminated with a UV wavelength absorbing material.

42. An air cleaning unit as in claim 38 wherein said fragrance dispensing means comprises:

a) a housing;

b) a containing means within said housing for containing a reserve of fragrance therein;

c) a capillary pipe means for moving fragrance from said containing means to a means for permitting the frgrance to contact air;

d) a means for regulating air pressure in said containing means to force movement of said fragrance into said capillary pipe means and into said air contacting means.

43. An air cleaning unit as in claim 10 wherein said mesh means is acrylic fibers coated with a catalytic material.

44. An air cleaning unit as in claim 10 wherein said mesh means is a wire mesh.

45. An air cleaning unit as in claim 43 wherein said electromagnetic field creating means is a wire through which current may flow.

46. An air cleaning unit as in claim 45 further comprising a light source.

47. An air cleaning unit as in claim 46 wherein said wire is coiled around said light source.

48. An air cleaning unit as in claim 47 wherein said coiled wire and said light source are connected in series.

49. An air cleaning unit as in claim 44 wherein said electromagnetic field creating means is a wire through which current may flow.

50. An air cleaning unit as in claim 49 further comprising a light source.

51. An air cleaning unit as in claim 50 wherein said wire is coiled around said light source.

52. An air cleaning unit as in claim 51 wherein said coiled wire and said light source are connected in series.

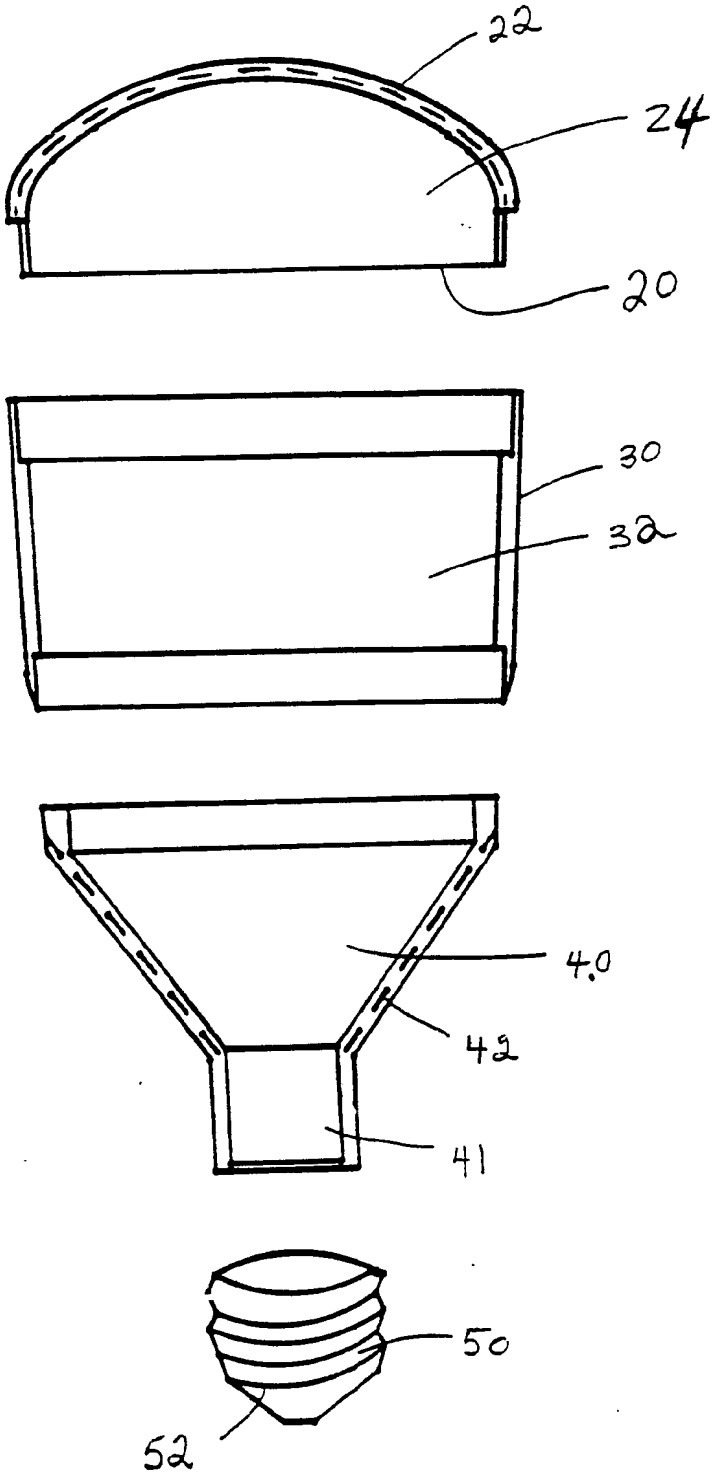

FIG. 1

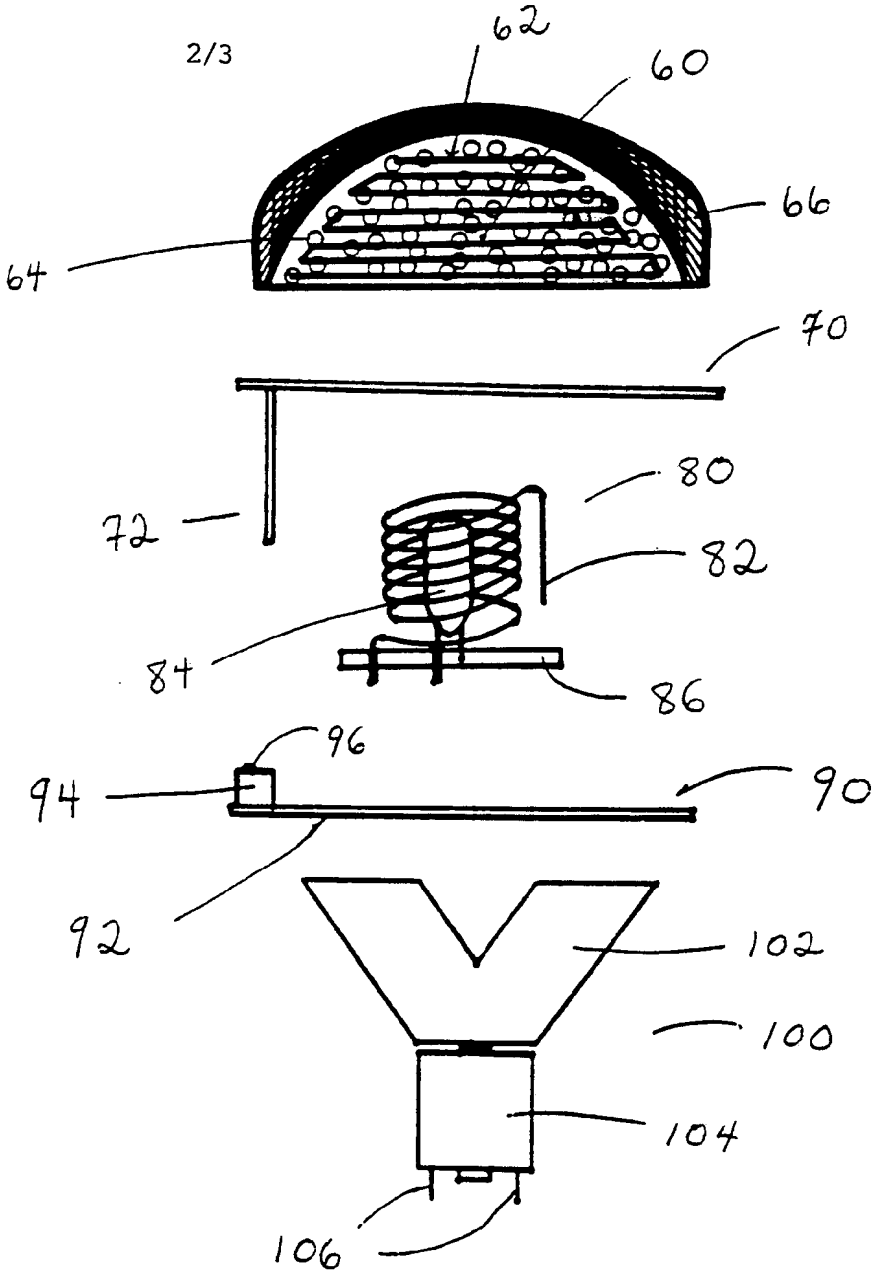

FIG. 2

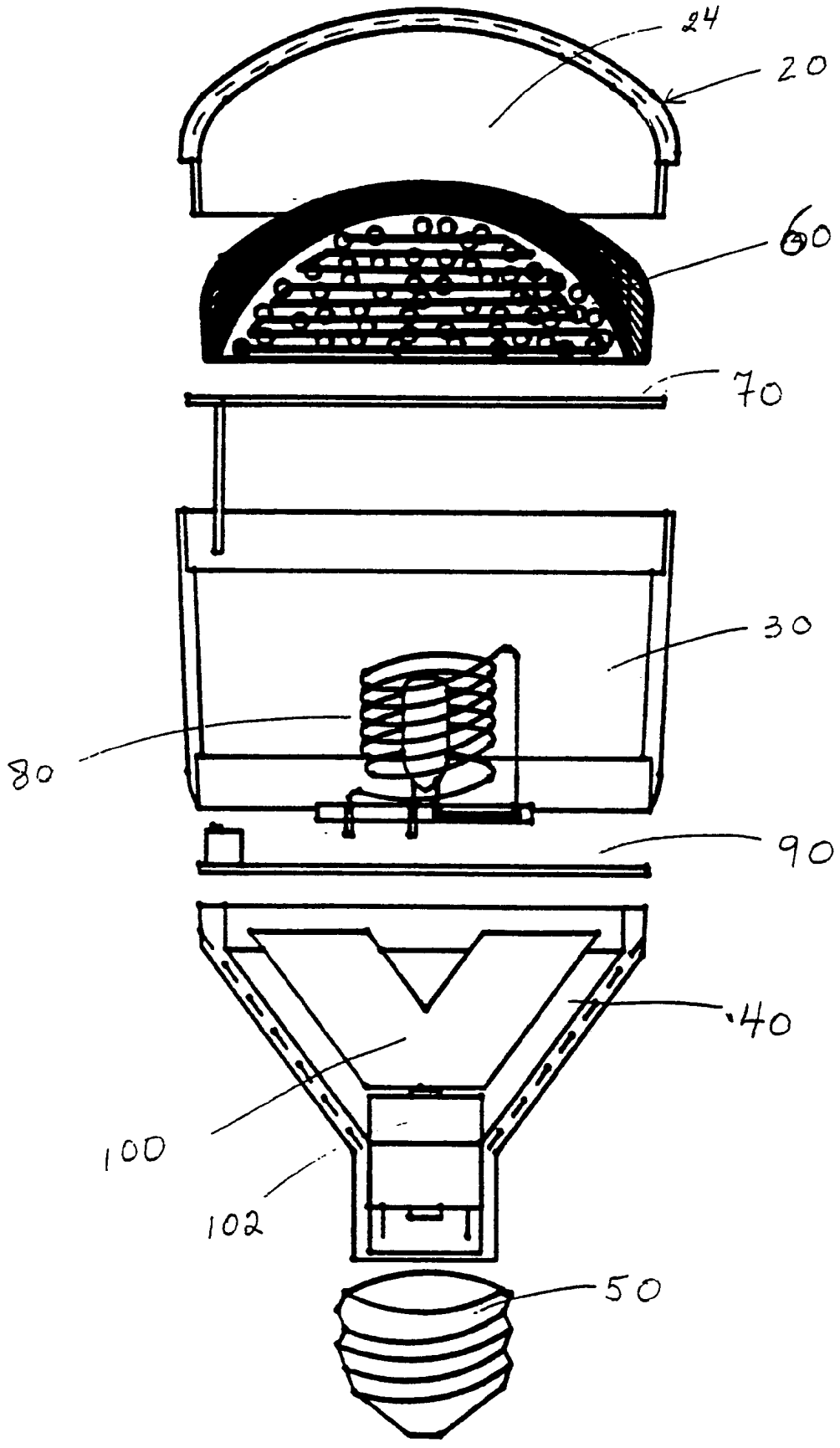

FIG. 3

INTERNATIONAL SEARCH REPORT

International Application No PCT/US90/03968

I. CLASSIFICATION OF SUBJECT MATTER (if several classification symbols apply, indicate all) 3

According to International Patent Classification (IPC) or to both National Classification and IPC

IPC(5): A61L 9/00, 9/16; B01D 53/04, 53/32

U.S. CL.: 422/119, 121, 122, 124, 125; 55/126,279, 385.1, 467

II. FIELDS SEARCHED

Minimum Documentation Searched 4

Classification System	Classification Symbols
U.S.	422/4, 22, 119, 121, 122, 124, 125; 55/124, 126, 279 385.1, 385.8,467,473

Documentation Searched other than Minimum Documentation to the Extent that such Documents are Included in the Fields Searched 5

III. DOCUMENTS CONSIDERED TO BE RELEVANT 14

Category *	Citation of Document, 16 with indication, where appropriate, of the relevant passages 17	Relevant to Claim No. 18
X Y	US, A, 3,744,216 (HALLORAN) 10 July 1973, See the entire document.	1-3,6,7,9 10,13,14,17 18,25,26, 29 & 30
A	US, A, 2,790,510 (BRABEC) 30 April 1957, See figure 1.	4,5,8,11,12, 15,16,19-24, 27,28 & 31-52
A	US, A, 2,136,254 (SARGENT) 08 November 1938, see figure 1.	

* Special categories of cited documents: 15

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IV. CERTIFICATION

Date of the Actual Completion of the International Search 2	Date of Mailing of this International Search Report 2
21 September 1990	12 DEC 1990
International Searching Authority 1	**Signature of Authorized Officer 20**
ISA/US	JILL JOHNSTON